

# JAPAN

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JIS Z 4501 (2011) (English): Testing method of lead equivalent for X-ray protective devices

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*The citizens of a nation must  
honor the laws of the land.*

Fukuzawa Yukichi

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INDUSTRIAL  
STANDARD

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**JIS Z 4501** : 2011

(JIRA/JSA)

**Testing method of lead equivalent  
for X-ray protective devices**

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Industries Association of Radiological Systems (JIRA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS Z 4501**:1988 is replaced with this Standard.

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## Testing method of lead equivalent for X-ray protective devices

### Introduction

This Japanese Industrial Standard was established in 1957 and has gone through 4 revisions to this day. The last revision was made in 1988, and it is revised this time since the standard cited was withdrawn after that.

In this Standard, the terms in boldface are those defined in **JIS Z 4005**. If the terms defined in the said standard are not indicated by boldface, the definitions are not applied and the meaning is interpreted according to the context.

### 1 Scope

This Standard specifies the testing method for the **lead equivalent** of protective devices, protective materials, etc. against **X-ray tube voltages** of 10 kV or over up to and including 400 kV.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS Z 4005 *Medical radiology—Terminology*

JIS Z 4511 *Methods of calibration for exposure meters, air kerma meters, air absorbed dose meters and dose-equivalent meters*

### 3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS Z 4005** apply.

### 4 Principal of test

The dose rates of the standard lead plate and specimen are measured, the attenuation rate curve of the standard lead plate is prepared and the **lead equivalent** (mm Pb) of specimen is obtained according to interpolation.

### 5 Test X-ray

The **radiation quality** of **X-ray** used for the test shall be as follows.

- a) The test of protective devices used for protection against **X-ray** with **tube voltages** of less than 150 kV shall be performed by using **X-ray** with **tube voltage** of 100 kV and a **total filtration** of not less than 0.25 mm Cu.
- b) The test of protective devices used for protection against **X-ray** with **tube voltage** of 150 kV or more shall be performed by using the **tube voltage** as specified in the relevant Japanese Industrial Standard if applied. In the case of those not covered by the Japanese Industrial Standards, **tube voltages** and **total filtrations** shall be as given in table 1.



**Table 1 Total filtration**

<b>X-ray tube voltage</b> kV	150	200	250	300	400
<b>Total filtration</b> mm Cu	0.7	1.2	1.8	2.5	3.5

- c) The **percentage ripple** of the test **tube voltage** shall be not exceed 4 %.

Moreover, when the measurement of test **tube voltage** is difficult, it can be replaced by the measurement of **X-ray** output. And, in such a case, the variation rate of **X-ray** output shall be not more than 4 %.

## 6 Test equipment

The test equipment shall be as follows.

**6.1 X-ray generator** The **X-ray generator** used for this test shall generate the **X-ray** specified in clause 5 and the **X-ray** output shall be stable.

**6.2 X-ray measuring apparatus** The **X-ray** measuring apparatus used for this test shall be calibrated according to **JIS Z 4511**.

**6.3 Standard lead plate** The standard lead plate to be used for this test shall be that of thickness known, of dimension larger than that of **X-ray** beam used and of purity not less than 99.9 %.

## 7 Test method and procedure

The test method shall be as follows.

- a) The **X-ray** beam used for the test shall be a wide **X-ray** beam. However, where the specimen is small and where the examination of the uniformity of lead equivalent of the specimen is intended, a narrow beam shall be used.
- b) The test apparatus shall be assembled, as shown in figure 1 a) when using wide **X-ray** beam, and as shown in figure 1 b) when using a narrow **X-ray** beam. In both cases, the **X-ray** beam shall be restricted to the required size by means of the adjustable diaphragm or irradiation tube attached to the **radiation aperture**.

Moreover, the fixed diaphragm shall be composed of the shielding substance not influencing upon **X-ray** and shall have circular aperture.

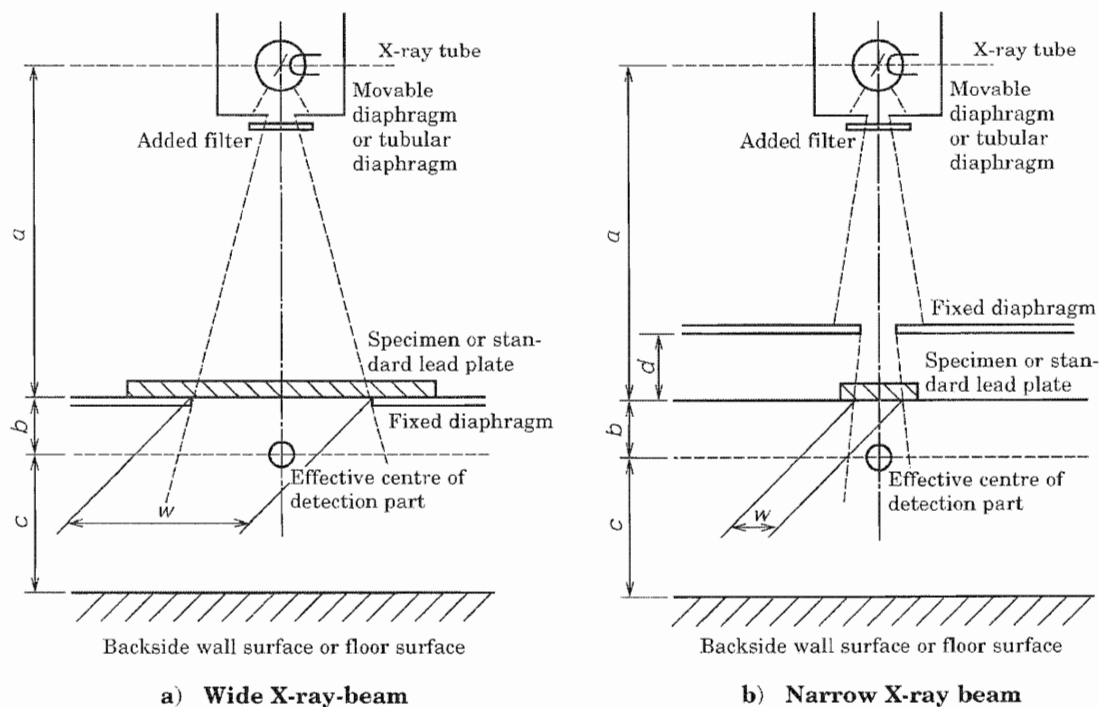
- c) The attenuation rate shall be the relative value of the dose rate when the specimen or standard lead plate is put to the dose rate when the specimen or standard lead plate is not put.
- d) The attenuation curve shall be prepared from three or more standard lead plates with different thickness. In such a case, the standard lead plate shall be selected so that the attenuation rate of the specimen becomes near to the centre.
- e) The attenuation rate curve of the standard lead plate shall be prepared from the lead thickness and attenuation rate of the standard lead plate and the lead thickness corresponding to the attenuation rate of the specimen shall be obtained according to interpolation and it shall be the **lead equivalent** (mm Pb) of the specimen.

## **8 Report of test result**

The test results shall be reported with the following information.

- a) Testing site
- b) Form of **X-ray equipment**
- c) Form of measuring apparatus and detector
- d) Date of test
- e) Name of specimen
- f) Test **tube voltage**
- g) **Total filtration**
- h) Size of **X-ray** beam
- i) Interpolation
- j) Test results
- k) Name of person in charge of test





Unit: mm

X-ray beam condition	$w$	$a$	$b$	$c$	$d$
Wide X-ray beam	500	1 500	$50 \pm 1$	700 min.	—
Narrow X-ray beam	20 <sup>a)</sup>				200

$w$ : diameter of X-ray beam

$a$ : distance between X-ray source and specimen or standard lead plate

$b$ : distance between the specimen or standard lead plate and the effective centre of detection part

$c$ : distance between the effective centre of detection part and the backside wall surface or floor surface

$d$ : distance between the fixed diaphragm and the specimen or standard lead plate

Note <sup>a)</sup> When the uniformity test for lead equivalent is carried out, it shall be not more than 10 mm.

**Figure 1 Test equipment in the case of using X-ray beam**

Errata for JIS (English edition) are printed in *Standardization and Quality Control*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

Errata will be provided upon request, please contact:

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